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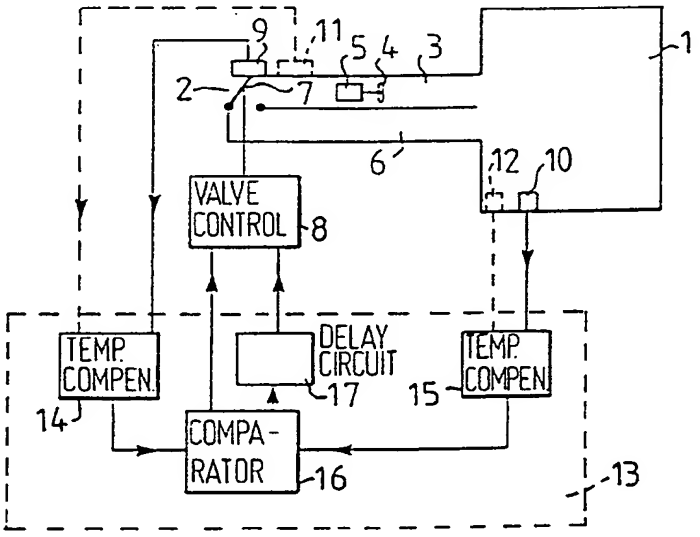

(57) Abstract

An arrangement for automatically controlling the air conditioning of a vehicle, comprising a vehicle interior fan (4, 5) and a recirculation valve (7) arranged adjacent a fresh air intake (2). The valve can be steered between two valve settings. When the valve is adjusted to a first setting, external air is taken into the vehicle. When the valve is adjusted to the second of its two settings, the air in the vehicle interior is recirculated. An impurity sensor (9) is connected to an input of a control device (13), which is constructed to compare the output signal of the air impurity sensor (9) with a calculated or detected instantaneous value of air impurities within the vehicle interior and to adjust the recirculating valve (7) to its recirculating mode when the outer signal of the air impurity sensor (9) indicates a value which is higher than the air impurity value in the vehicle interior.

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vehicle air conditioning control arrangement

The present invention relates to an arrangement of the kind set forth in the preamble of claim 1.

The drivers and passengers of road vehicles are exposed to higher concentrations of poisonous gases and corresponding contaminating substances from road traffic than others. This exposure to contaminating substances is a serious problem, especially in the case of professional drivers and those who spend much of their time in city traffic, vehicle queues and tail backs, road tunnels, etc. Fresh air is supplied from outside the vehicle to the vehicle interior through an air intake. Although the air intake is often located high up in the vehicle, this is not sufficient to avoid the intake of poisonous and contaminating substances from the surroundings.

It is known to recirculate air temporarily in the interior of a vehicle. For instance, US 4 478 049 describes an arrangement in which a gas sensor for detecting air impurity levels is located in the vehicle fresh air intake. When the detected level of impurity content is found to be above a first predetermined value, a recirculating valve is activated, so as to close off the fresh air intake, and to open an air recirculating path. When the detected impurity level is found to lie beneath a predetermined second value, below said first level, the recirculation valve is again activated, so as to re-open the air intake and to close the recirculation path. The detection levels can be re-set between two values in dependence on the degree of impurity of the surrounding air. US 4 259 722 describes a similar arrangement. In this case, the recirculation of air within the vehicle interior is discontinued in response to signals produced by carbon-dioxide sensors or humidity sensors positioned in the vehicle interior.

The concentration or content of air impurities will change constantly during the journey travelled by the vehicle. The object of the invention is to create an interior environment which contains the minimum possible air-carried contaminants or impurities, irrespective of the degree of pollution of the air externally of the vehicle. This problem is achieved with an arrangement having the characterizing features set forth in claim 1. Further features and developments of the inventive arrangement are set forth in the remaining claims.

By continously detecting the impurity content of the air at the air intake and switching the air conditioning system to its recirculating mode immediately the impurity content of the air externally of the vehicle is higher than that within the vehicle, the impurities in the air present in the vehicle interior will be decreased not only when the air externally of the vehicle is relatively heavily polluted, but always as soon as the level of impurities in the ambient air rises, even though the air at that time is only moderately polluted. This enables the level of air pollution in the vehicle interior to be reduced to a minimum.

The invention will now be described in more detail with reference to the accompanying drawings, in which
Figure 1 is a block schematic of a first embodiment of the invention, and
Figure 2 is a block schematic of a second embodiment of the invention.

Like parts or parts having mutually the same function in the two illustrated embodiments have been identified with the same reference signs.

In the block schematic of Figure 1, the reference 1 identifies the interior of a vehicle, said interior being

connected to a fresh air intake 2, via a first air conduit 3 provided with a fan 4 driven by a fan motor 5. As is conventional with vehicle installations, the speed of the fan motor 5 can be controlled from an instrument panel, although the manner of motor control is irrelevant to the embodiment of Figure 1.

The illustrated embodiment includes a second air conduit 6, which although shown in the Figure to be positioned adjacent the conduit 3 may, in practice, be placed in some other suitable location. The air conduit 6 discharges close to the air intake 2 and has at this location an opening which communicates with the first conduit 3. Arranged in this opening is a butterfly valve 7, which, by means of a valve control device 8, can be adjusted between a first valve setting, in which the valve closes the opening between the conduits 3 and 6 and in which the fresh air intake 2 is open, and a second valve setting (not shown in the Figure), in which the valve 7 closes the fresh air intake and holds the communication between the conduits 3 and 6 open. It will be understood that the valve 7 need not have the form illustrated schematically in the Figure, but may have any suitable form, for instance may comprise two mutually opposed valves which are controlled simultaneously, the one valve being located in the air intake and the other valve in the opening between the conduits 3 and 6.

A first air impurity sensor 9 is positioned in the proximity of the fresh air intake 2 or in the intake itself. A second air impurity sensor 10 is positioned within the vehicle interior 1. The air impurity sensors 9 and 10 are mutually of the same kind and are also mutually matching. In order to compensate for any dependency on temperature which the sensors might have, a respective temperature sensor 11 and 12 may be placed in the proximity of each of the impurity sensors. The impurity sensors 9 and 10, for

instance, may be of the kind effective in detecting the carbon dioxide content of the air, although sensors for detecting the presence of other types of gases may also be used. Multiple sensors for detecting different types of impurities, such as other types of gas, including dust and the like, may also be used.

The analogue signals produced by the sensors 9 and 10, and also, when installed, the sensors 11 and 12, are fed to a control device 13, which may be of a kind constructed from analogue elements. When compensating for temperature, the signals are fed from the sensors 9 and 11 to a first temperature compensation circuit 14 and the signals from the sensors 10 and 12 are sent to a second temperature compensating circuit 15. The outputs of the circuits 14 and 15 are each fed to a respective input of a comparator 16, which when the signal from the circuit 14 is higher than the signal from the circuit 15 steers the valve control device 8 in a manner to adjust the valve to its second position, such as to close the fresh air intake 2 and open the recirculation path through the conduits 6 and 3. In the absence of temperature compensation, the signals from the sensors 9 and 10 are fed directly to the inputs of the comparator 16.

The comparator output signal can also be fed to a delay circuit 17, which after a predetermined time lapse steers the valve arrangement in a manner to switch the valve 7 back to its first setting, in which the air intake is open. Instead of a delay circuit 17, the comparator may be constructed to steer the valve device 8 to its valve re--setting mode when, subsequent to re-setting the valve 7 to its recirculation mode, the sensor 10 measures an air impurity content of given value which is higher than the air impurity content detected by the sensor 9.

As is usual in present times, the control device 13 and

its various functions can be replaced with a computer (or as a part program in a computer which is also utilized for other purposes), wherewith all incoming analogue signals are coupled to the control device 13 via analog/digital converters (not shown).

Figure 2 illustrates a second embodiment of the inventive arrangement. In the case of this embodiment, only one air impurity sensor 20 is provided, this sensor being located adjacent to or in the fresh air intake 2. The control device is preferably a computer which is constructed to calculate continuously the impurity content in the vehicle interior 1 during those periods in which the valve 7 holds the intake open, said calculation being made on the basis of the instantaneous impurity content measured by the sensor 20 at a previous, given point in time. The vehicle interior is preferably provided with a multiple of passenger sensors 22. Mutually different times can be decided for calculating the impurity content of the vehicle interior, in dependence on the number of people in the vehicle. The illustrated embodiment also includes an instrument panel 23, which can be connected to the control device 21. As is usual in present day vehicles, the driver is able to select the speed of the fan motor 5 of the fan 4, e.g. between four positions, this selection being made through the instrument panel 23. The speed of the fan motor 5 may also be controlled, instead, from the instrument panel independently of the control device, in which case signals from the fan motor 5 indicating fan speed are instead fed to the control device 21 (not shown). The control device 21 can also select the aforesaid given point of time at which the impurity content of the air is calculated in depence on prevailing fan speed.

Calculation of the air impurity content of the vehicle interior can be effected by simple computation of the averages of the values detected during said given time

period. Alternatively, it is also possible, however, to formulate averages with weighted values, such that the values detected at a later time during said given time period will obtain a higher weighting than the earlier detected values, in accordance with a given scale, which need not be linear. The scale selected may be different for different makes of vehicles. The control device 21 may also be programmed with mutually different calculating conditions with different scales for each conceivable combination of passenger number and selected fan speed.

The quality of the air in the vehicle interior is impaired slowly as the air is recirculated, and naturally it will be necessary to allow fresh air to enter from outside the vehicle after a given length of time has lapsed. Accordingly, subsequent to the valve control device 8 having adjusted the valve 7 to its recirculating position, the latest calculated value of air quality in the vehicle interior is used as a reference and the control device 21 effects a calculation of the impaired air quality in the vehicle interior along a time scale which is set in dependence of the number of people in the vehicle. Naturally, it is possible, as an alternative or in addition, to provide an extra air impurity sensor 24 within the vehicle interior, such as to measure the absolute air impurity content solely during those periods in which air is recirculated.

A certain degree of hysteresis is necessary, in order to achieve system stability. If the quantity of air impurities increases very slowly, the system, in some instances, may not switch to its recirculating mode, despite the fact that impurities are present at an elevated, and slowly increasing level. In this case, it is possible to use old values as a reference and switch to recirculation when the outer air constantly lies at an elevated level. Consequently, the control device 21 may

also be constructed to store the value detected at a precise moment in time, at regular time intervals, e.g. every ten minutes, and to compare this value with the value that was latest stored in this manner, and to steer the valve control device 8 in a manner to switch the valve 7 to its recirculating mode when the value latest detected in this manner exceeds the earlier detected value by a pre-determined amount.

It will be understood that modifications can be made within the scope of the invention.

CLAIMS

1. An arrangement for automatically controlling the air conditioning of a vehicle, which arrangement comprises a vehicle interior fan (4, 5) and a recirculation valve (7) which is positioned adjacent to a fresh air intake (2) and which can be switched between two positions, wherein when the valve occupies one of said positions air is taken in from outside the vehicle whereas when the valve occupies the other of said positions the air within the vehicle interior is recirculated, and which arrangement further includes a control device (13; 21) for adjusting the setting of the recirculation valve (7) and at least one air impurity sensor (9; 20) which is positioned adjacent the fresh air intake and is connected to an input on the control device, characterized in that the control device (13; 21) is constructed to compare the output signal of the impurity sensor (9; 20) with a calculated or detected instantaneous value of air impurities within the vehicle interior and to adjust the recirculating valve (7) to its recirculating mode when the otput signal of the impurity sensor corresponds to a value which is higher than the calculated or detected impurity value in the vehicle interior.

2. An arrangement according to claim 1, characterized in that at least one other, inner impurity sensor (10) is arranged in the vehicle interior and matched with the outer air impurity sensor (9) positioned adjacent the fresh air intake; and in that the output signal from the inner and the outer impurity sensors are compared by the control device, which adjusts the setting of the re-circulating valve (7) in accordance with the result of the comparison.

3. An arrangement according to claim 2, characterized in

that a temperature sensor (11, 12) is positioned adjacent each air impurity sensor; and in that the control device is constructed to carry out temperature compensation of the signal produced by each air impurity sensor, prior to making a comparison between the sensor output signals.

4. An arrangement according to claim 1, characterized in that the control device (21) is intended to calculate the concentration of the impurities in the air within the vehicle interior on the basis of values obtained from the air impurity sensor (20) located adjacent the fresh air intake, over a given time period prior to said instantaneous time point.

5. An arrangement according to claim 4, in which the speed of the interior fan (4, 5) can be controlled, characterized in that the control device (21) bases said given time at which said impurity concentration is calculated on the speed of the vehicle interior fan.

6. An arrangement according to claim 4 or 5, in which each vehicle seat is provided with a person detecting sensor (22), characterized in that the signals from all said person detecting sensors are fed to the control device (21), which calculates the aforesaid given time for said impurity calculation on the basis of the number of people in the vehicle.

7. An arrangement according to any of claims 4-6, characterized in that the control device is constructed to calculate the air impurity concentration with a weighted average computation over said given time period in accordance with a given weighting scale.

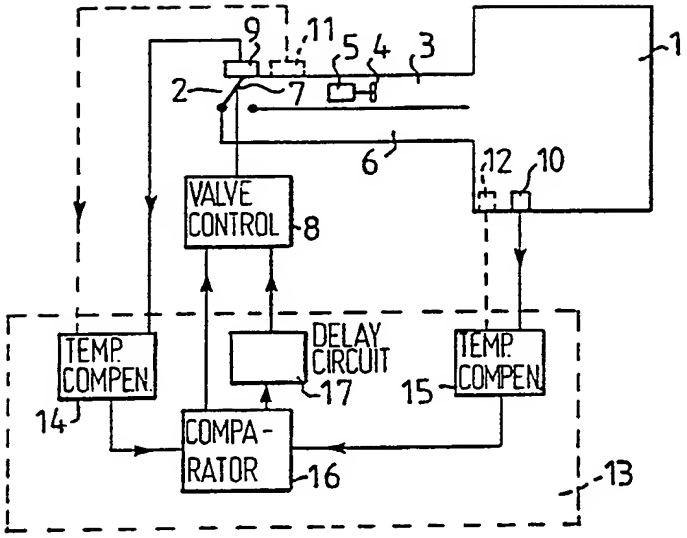
9
11
5
4
3
1
2
7
6
12
10
VALVE CONTROL
8
TEMP. COMPEN.
DELAY CIRCUIT
17
TEMP. COMPEN.
15
14
COMPA-RATOR
16
13

FIG.1

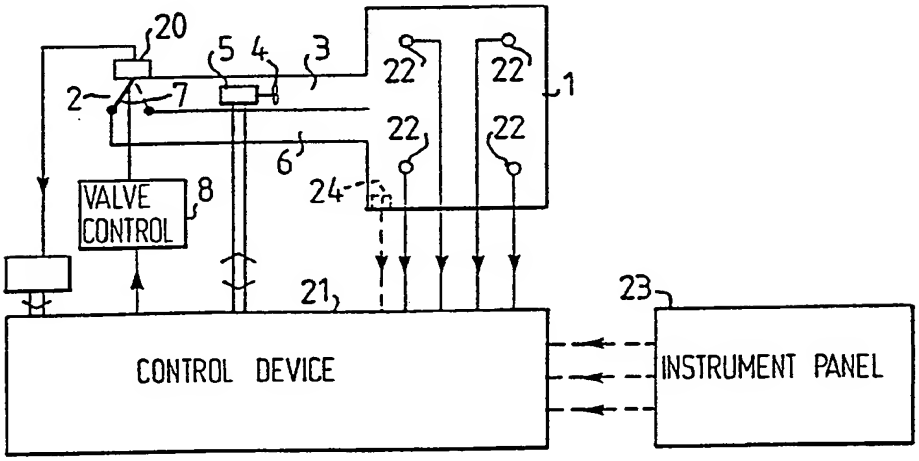
20
5
4
3
22
22
1
2
7
22
22
6
24
VALVE CONTROL
8
21
23
CONTROL DEVICE
INSTRUMENT PANEL

FIG.2

INTERNATIONAL SEARCH REPORT

International Application No PCT/SE89/00014

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC 4

B 60 H 1/00, 3/00

II FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC 4	B 60 H 1/00, 1/24, 3/00
US Cl	98:2, 2.01, 2.11

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched [8]

SE, NO, DK, FI classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	EP, A1, 0 042 287 (NIPPONDENSO CO. LTD) 23 December 1981	1
A	US, A, 4 259 722 (IWATA ET AL) 31 March 1981	1

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IV. CERTIFICATION

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